SPECIFICATION

1. TITLE OF THE INVENTION

DIAPHRAGM FOR ACOUSTIC EQUIPMENT

2. CLAIMS

(1) A diaphragm for acoustic equipment wherein a polyester film comprising naphthalenedicarboxylic acid and ethylene glycol is molded.

(2) A diaphragm for acoustic equipment wherein a film obtained by uniformly mixing reinforcements such as talc and potassium titanate fiber into polyester resin comprising naphthalenedicarboxylic acid and ethylene glycol is molded.

3. DETAILED DESCRIPTION OF THE INVENTION

INDUSTRIAL APPLICATION FIELD

The present invention relates to a diaphragm for speakers.

PRIOR ART

A polyethylene terephthalate film has conventionally been used as a diaphragm for speakers made of plastics. A polybisphenol phthalate type resin film has also been used for a diaphragm.

PROBLEMS TO BE SOLVED BY THE INVENTION

However, the former polyethylene terephthalate film diaphragm used for small-diameter speakers, such as speakers for small-sized radios and speakers for headphones, has comparatively high modulus of elasticity and yet low internal loss, so that bass reproduction is insufficient, and peaks and

dips occur easily in acoustic frequency characteristics. Then, when stiffness is decreased by thinning film thickness of the film, division resonance occurs easily, leading to the cause of generation of distortion during reproduction. Also with regard to heat resistance of this film, the atmosphere of a temperature of 65°C or more causes deformation easily by reason of the thin film, leading to the cause of abnormal sound.

In addition, a diaphragm made of the latter film has low stiffness and lacks rigidity, so that bass reproduction is good and yet reproduction band of sound is narrow, and when the film thickness is thinned, distortion occurs by reason of lacking rigidity of the diaphragm to leave the defect such that rattle occurs easily in resistance to input of speakers.

Then, the present invention provides a diaphragm for speakers so excellent as to solve the above-mentioned defect.

MEANS FOR SOLVING THE PROBLEM

In order to solve this problem, the present invention is a molded product of a polyester film comprising naphthalenedicarboxylic acid and ethylene glycol.

FUNCTION

A film diaphragm having the present composition has so high internal loss though rigidity thereof is higher than that of a polyester film that division resonance of the diaphragm is infrequent, reproduction band of sound is wide and frequency characteristics is excellent even though film thickness of the film is thinned.

EXAMPLES

A speaker diaphragm in an example of the present invention is

hereinafter described.

First, in Fig. 1, "1" is a magnetic circuit and this magnetic circuit 1 is composed of a plate 3, a yoke 4 and a columnar magnet 2.

A frame 6 is joined to such a magnetic circuit 1, and a gasket 7 and a voice coil 5 are joined to the peripheral portion of this frame 6 and the central portion of a diaphragm 8 respectively, and are fit into a magnetic gap 9 of the above-mentioned magnetic circuit 1 without decentering.

(1) In speakers having such a composition, the diaphragm 8 is obtained in such a manner that a film comprising naphthalenedicarboxylic acid and ethylene glycol, for further details a film comprising polyethylene 2,6-naphthalate resin having a naphthalene ring in a molecular chain, represented by the following chemical structural formula is heated in a temperature atmosphere of 180 to 230°C and mold-pressed with a metal mold warmed up to a temperature of approximately 20 to 50°C.

[Chemical Formula]

This has a melting point of 272°C, which makes little difference as compared with a generally used polyethylene terephthalate resin film (the trade name of Mylar), and yet as high a glass transition point as 113°C, and so favorable heat resistance in heat deformation after being molded into a diaphragm shape as to cause little deformation even in an atmosphere of a temperature of approximately 100°C. The table is as follows.

	melting point	glass transition point
polyethylene 2,6-naphthalate (the present invention film)	272℃	113℃
polyethylene terephthalate (conventional product)	264℃	68℃

Heat resistance, namely, deformation of the diaphragm after standing in temperature atmosphere for 24 hours is shown in the following table.

	70℃	85℃	100℃	110℃
polyethylene 2,6-naphthalate (thickness of 50μ)	○	○	○	×
polyethylene terephthalate (thickness of 50μ)	×	×	×	×

Thus, the diaphragm of the present example has so high glass transition point as to offer favorable heat resistance. On the other hand, a diaphragm made of a polyethylene terephthalate resin film as a conventional product causes such deformation in a temperature atmosphere of 70°C or more that the standing of a small-sized radio equipped with a speaker employing a conventional diaphragm particularly in a cabin in the summertime leads to the cause of abnormal sound occasionally in the case where the inside of a car becomes in a temperature atmosphere of 70°C or

more. However, a small-sized radio equipped with a speaker employing the present example diaphragm performs function thereof sufficiently to offer favorable sound quality even in high temperature atmosphere.

(2) A conventionally used polyethylene terephthalate film diaphragm has so great heat shrinkage distortion of the film in a temperature atmosphere of 180 to 230°C that creases of the film occur easily and the thickness becomes nonuniform even though the outer periphery of the film is retained, and distortion due to heat shrinkage remains to easily cause deformation after being molded even though forcibly molded with a metal mold. On the other hand, the film (polyethylene 2,6-naphthalate resin film) used for the diaphragm of the present example has so little heat shrinkage in the above-mentioned temperature atmosphere that the film thickness becomes uniform and the whole film becomes flexible to cause little deformation after being molded.

Through the above, the present example film diaphragm is greatly favorable also in division resonance as compared with a conventionally used polyethylene terephthalate resin film diaphragm, and offers little deformation and is easily molded.

(3) The present example film diaphragm has favorable rigidity and higher modulus of elasticity by 50% or more than polyethylene terephthalate and favorable specific modulus of elasticity, and additionally the merit such that tanδ is large; the film diaphragm for speakers exhibits ideal physical property values.

That is, a speaker employing the present example has so high rigidity that treble threshold frequency is high and band of sound is wide. Even

though the film thickness is thinned, tanδ is so large that division resonance of the diaphragm is infrequent to provide a speaker having favorable sound quality and excellent frequency characteristics.

The physical property values of the film diaphragm of the present example and film diaphragms as conventional products are shown below.

The physical property values are examined by a vibrating reed method and the film thickness is 50μ (actual measurements).

	density (g/cm^3)	modulus of elasticity (dyn/cm^2)	specific modulus of elasticity (cm^2/sec^2)	bending rigidity (dyn/cm)	tanδ
the present invention film diaphragm	1.34	$6.16*10^{10}$	$4.60*10^{10}$	$1.77*10^3$	$3.79*10^{-2}$
PET polyethylene terephthalate	1.40	$3.74*10^{10}$	$2.67*10^{10}$	$1.62*10^3$	$2.09*10^{-2}$
PES polyether sulfone	1.37	$2.54*10^{10}$	$1.52*10^{10}$	$1.10*10^3$	$2.13*10^{-2}$
PA polyallylate	1.22	$1.98*10^{10}$	$1.62*10^{10}$	$8.11*10^2$	$2.04*10^{-2}$

As described above, the physical properties of the present invention diaphragm film have ideal values as a diaphragm as compared with the physical properties of other films.

(4) Next, the frequency characteristics of a film diaphragm used for a microspeaker are shown in Fig. 2.

The characteristics are compared on the condition that the input is 0.1 W (1 kHz) and the distance between a speaker and a microphone is 0.5 m.

"A" in Fig.2 denotes the characteristics of a speaker employing a polyallylate film diaphragm, "B" denotes the characteristics of a speaker employing a polyethylene terephthalate film diaphragm, and "C" denotes the characteristics of a speaker employing the present example film diaphragm; the present example can provide wide band of sound and excellent sound quality.

The addition of talc, potassium titanate and the like as reinforcement to resin of the present example also allows the physical properties and heat resistance of the film diaphragm to be improved; for example, the addition of potassium titanate powder by 10% improves modulus of elasticity by approximately 15% and heat resistance by 5 to 10%.

ADVANTAGEOUS EFFECT OF THE INVENTION

The present invention offers favorable heat resistance by reason of being constituted as described above, and additionally a film diaphragm has so favorable modulus of elasticity and large tanδ that the present invention can provide a speaker having ideal physical property values and favorable sound quality in wide band, leading to great industrial value.

4. BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a half section showing an example of a speaker employing the present invention, and Fig. 2 is a frequency characteristic view of a speaker

employing the present invention diaphragm and a speaker employing a conventional diaphragm.

1: magnetic circuit, 2: magnet, 3: plate, 4: yoke, 5: voice coil, 6: frame, 7: gasket, 8: film diaphragm, 9: magnetic gap.